



612.40276X00

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicants: C. Barroux

Serial No.: 09/899,105

Filed: July 6, 2001

For: MODELLING METHOD ALLOWING TO PREDICT AS A FUNCTION  
OF TIME THE DETAILED COMPOSITION OF FLUIDS PRODUCED  
BY AN UNDERGROUND

Art Unit: 2128

Examiner: Phan, T.

**REQUEST FOR RECONSIDERATION**

Mail Stop: Amendment (Fee)  
Commissioner For Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

May 26, 2005

Sir:

This is in response to the Office Action mailed January 26, 2005, in  
connection with the above-identified application.

Claims 1 to 5 stand rejected under 35 U.S.C 103(a) as being unpatentable  
over U.S. Patent 6,108,608 to Watts, III, in view of "applicant's admitted prior."  
Applicant traverses this rejection and requests reconsideration thereof.

The present invention is characterized by seven steps:

The first step is the discretization of the reservoir by means of grid.

The second step is determining the variation of thermodynamic parameters of  
the non-aqueous phases necessary for Black Oil simulation during stages of a  
thermodynamic path followed by the fluids in the reservoir. At this step, the  
determination of phase thermodynamic parameters necessary for Black Oil  
simulation (viscosity and density) do not imply any mathematical model, but the

interpretation of measurements performed in laboratories, operational site, etc. This step is clearly not described in Watts, III.

The third step is to define the fluids by a detailed representation with component and pseudo-component. At this step, the determination of the detailed representation is not mathematical, but comes from the interpretation of measurements (as gas chromatography analysis,...) performed from laboratories, operational site, etc.

The fourth step determines at least one equation of state with  $n$  parameters allowing to simulate the thermodynamic behavior of the fluids during the stages of the thermodynamic path followed. This step is not the Black Oil simulation. This step is a preparation stage for the input data of the Black Oil simulation. This step can be considered as the originality of the invention according to other prior art concerning Black Oil simulation with a delumping stage. The invention combines a Black Oil simulation with a delumping stage wherein no solution of an equation of state is required at any time interval.

The fifth step is a preparation stage for the input data of the Black Oil simulation. The thermodynamic behavior of each non-aqueous phase are converted into input data suited for a Black Oil type thermodynamic representation. This step is mandatory for Black Oil simulation.

The sixth step is a Black Oil modeling step. This step allows to determine in each cell and at successive time intervals, thermodynamic characteristics of each non-aqueous phase and data representative of phase displacements in the reservoir.

The seventh step corresponds to a delumping operation in order to obtain the detailed composition of the fluids in each cell. This delumping method is possible only if step 4 is performed.

The invention, which combines a Black Oil simulation with a delumping stage wherein no solution of an equation of state is required at any time interval, is not described in any prior art.

The Watts, III patent discloses a method for estimating properties of a multi-component fluid using pseudocomponents. The fluid is characterized using a set of base components and a set of fluid compositions is defined that corresponds to fluid compositions expected to occur in computations of interest. Pseudocomponents are defined to represent the multi-component fluid by (i) defining an ordered set of vectors corresponding to a characteristic of the base components, each vector containing one entry for each base component, the first vector being most representative of the set of compositions according to a predetermined criterion and each vector thereafter in the set being less representative of the set of compositions than the vector before it, and (ii) selecting a subset of the ordered set that comprises the first vector and a predetermined number of vectors immediately thereafter, the subset of vectors corresponding to a pseudocomponent characterization of the multi-component fluid.

The method described in Watts, III does not anticipate Applicant's invention, since the method described in this document is absolutely not applicable to the delumping of a Black Oil type simulation, and since Applicant's invention is totally dedicated to the delumping of a Black Oil type simulation. The method described by Watts, III is not applicable to a Black Oil simulation for at least the following reasons.

The pseudocomponents in a Black Oil simulation cannot fulfill the mathematical process described in Watts, III. The pseudocomponents in a Black Oil simulation are based on a physical process which do not allow for eliminating one

particular base component. In other words, in a Black Oil simulation, all base components are present in all pseudocomponents, which is not the case in Watts, III.

Watts, III discloses a mathematical modeling of the fluid, such as that described at column 4, lines 36-46, using an equation of state such as the equation of Peng-Robinson. However, this equation cannot be used in a Black Oil simulation.

Step 5 of Applicant's invention is not described in Watts, III. However, this step is mandatory for a Black Oil simulation, and is out of purpose in a compositional context as that used by Watts, III.

For the foregoing reasons, the Watts, III patent clearly does not disclose at least the second, fourth, fifth and sixth steps presently claimed. Accordingly, clearly the Watts, III patent does not anticipate and would not have suggested the presently claimed invention.

While the Examiner alleges that it would have been obvious to modify the estimating method of Watts, III by incorporating Peng-Robinson's state equation to model and simulate the oil reservoir as a continuous function of thermodynamic parameters, doing so would not remedy the basic deficiencies noted above with respect to Watts, III. Moreover, as noted above, the present invention combines a Black Oil simulation with a delumping stage wherein no solution of an equation of state is required at anytime interval. Such would not be suggested by the proposed modification of Watts, III, by incorporating Peng-Robinson's state equation as proposed by the Examiner. Accordingly, the presently claimed invention is patentable over the proposed combination of Watts, III and "applicant's admitted prior art."

Applicant notes the Examiner has cited the patent to Poe, Jr. as being pertinent to Applicant's disclosure. However, since this patent was not applied in


rejecting the claims in the application, further discussion of this patent is deemed unnecessary.

In view of the foregoing remarks, favorable reconsideration and allowance of all of the claims now in the application are requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 612.40276X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

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